COLORADO RIVER RECOVERY PROGRAM FY 2006 ANNUAL PROJECT REPORT

RECOVERY PROGRAM PROJECT NUMBER: 123

- I. Project Title: Smallmouth bass control in the middle Green River
- II. Principal Investigator(s):

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III. Project Summary:

The purpose of this project is to minimize the expansion of smallmouth bass in the Green River. The objectives to meet this goal are 1) Calculate an annual population estimate of smallmouth bass in the Green River, 2) Remove smallmouth bass from the middle Green River from Echo Park (RM 344) to Swasey's Rapid (RM 132) and, 3) Assess the effectiveness of removal efforts. The removal reach was split into three sections (Echo Park, Ouray and Desolation Canyon) with a principle investigator assigned to each reach.

We sampled the river using two electrofishing boats sampling both shorelines on at least four occasions in 2004, 2005, and 2006. To evaluate removal success, we calculated the initial size of the population each year using mark-recapture methods. Additional assessments were made through examination of trends in distribution, catch rates, and population size structure.

In 2006 removal efforts were focused on habitats which were most likely to contain smallmouth and in the Echo Park reach an extra pass was completed using electric seines to focus on removing age 0-1 cohorts.

- IV. Study Schedule: 2004 2006
- V. Relationship to RIPRAP:

GENERAL RECOVERY PROGRAM SUPPORT ACTION PLAN

- III. Reduce negative impacts of nonnative fishes and sportfish management activities (nonnative and sportfish management).
- III.A. Reduce negative interactions between nonnative and endangered fishes.
- III.A.2. Identify and implement viable active control measures.

GREEN RIVER ACTION PLAN: MAINSTEM

- III. Reduce impacts of nonnative fishes and sportfish management activities (nonnative and sportfish management).
- III.A.4. Develop and implement control programs for nonnative fishes in river reaches occupied by the endangered fishes to identify required levels of control. Each control activity will be evaluated for effectiveness, and then continued as needed.
- III.A.4.b.(2) Smallmouth bass in the middle and lower Green River.
- VI. Accomplishment of FY 2006 Tasks and Deliverables, Discussion of Initial Findings and Shortcomings:

In all sections electrofishing was the primary gear type used to collect smallmouth bass for a mark-recapture abundance estimate. Four complete shoreline electrofishing passes were completed in each reach of the Green River. On the first electrofishing pass smallmouth bass were marked and on the remaining three passes smallmouth bass were examined for marks and removed from the river. In the Echo Park reach an additional pass was completed using electric seines to focus on the age 0-1 cohorts.

Task 1. Complete four smallmouth bass collecting passes from Echo Park to Split Mountain boat ramp (USFWS CRFP – Vernal)

The USFWS sampled the furthest upstream 26-mile reach from Echo Park (RM 344) downstream to Split Mountain boat ramp (RM 318). This effort started with a marking pass June 18-20. Two electrofishing rafts were used to continuously shock along both shorelines of the entire river reach. During the first pass, 199 smallmouth bass were measured, weighed, marked (green Floy tags), and released back to the river alive. Three electrofishing passes were then completed during which 749 bass >100mm were removed, 20 being recaptures (Table 1a). The number of smallmouth bass removed per river mile was 29, compared to 28 in 2005 and 94 in 2004. No tagged fish from outside the study area were collected. After pass 4, another pass was added to target the age 0-1 cohort. During this pass an electric seine was used to sample shallow areas with small boulder substrates, and 670 bass < 100 mm were collected mainly from areas not accessible to shocking rafts.

Table 1a. 2006 Smallmouth bass collected from Echo Park to Split Mountain Boat Ramp.

Echo Park – Split Mountain	Date	Marked	Recaptures	# Removed >100mm	# Removed <=100mm	Catch/hr >100mm	Catch/hr <=100mm
Pass 1	7/18-20	199	N/A	7	1	9.15	.04
Pass 2	7/26-28	0	6	123	64	6.60	3.44
Pass 3	8/14-17	0	11	404	768	19.16	36.42
Pass 4	8/22-24	0	3	206	561	9.45	25.72
Pass 5 (Seine)	9/5-6	0	0	9	670	4.05	301.80
Total		199	20	749	2064	8.81	24.56

Abundance Estimate

The smallmouth bass population estimate was calculated using both the Adjusted Peterson model and a closed capture model in program Mark (Table 2a). All recaptures and unmarked captures in their respective passes were first considered using the Adjusted Peterson estimate, but for reason of an increasing N per pass (being indicative of closure violation), only the first (marking) and second (removal) passes were used. For pass 1 and 2 and the Adjusted Peterson approach, the point estimate is 3,543 bass with an estimated probability of capture .056 (p-hat). From this point estimate, a 21% reduction in population was attained or with intervals of confidence (95%) the percent reduction ranged from 12 - 67%, Table 2a. Once again, estimates which combined catch and recapture criteria for passes 1-3 and 1-4 resulted in increases in the point estimate which may be indicative of a short closure period.

Under the assumption that closure is violated within 2-3 weeks, a two-pass estimate using program Mark was also calculated. With this model the 2006 point estimate is 4,053 bass with probability of capture (p-hat) 0.0838. From this estimate an 18% population reduction was attained, or when considering confidence limits (95%) the measure of reduction ranged from 9 – 38%, and the post-removal estimate is 3,304 sub-adult and adult bass, Table 2a.

Table 2a. 2004-2006 smallmouth bass population estimates from Echo Park to Split Mountain Boat Ramp.

Year	Туре	Model	N	CI	SE	P-hat	CV	Removed	Deplet.
2004	Mark	M(t)	8,000	5,306- 12,294	174	.058	.22	2,440	31%
2005	Adj. Peterson	M(t)	3,203	1,464- 4943	870	.089	.27	718	22%
2005	Mark	M(t)	3,437	2,048- 6006	973	.083	.28	718	21%
2006	Adj. Peterson	M(t)	3,543	1,109- 5,976	1,217	.056	.34	749	21%
2006	Mark	M(t)	4053	1997- 8625	1589	.049	.39	749	18%

Size Structure

Mean total length (TL) of smallmouth bass collected for the first pass was 166 mm. Length data show the strongest size class to be 150-175 mm (Figure 1a). The size class next most caught was the age ones, 75 - 100 mm which indicates good recruitment in 2005 (Carlander 1977). 1,837 more bass of this size were caught but lengths were not recorded.

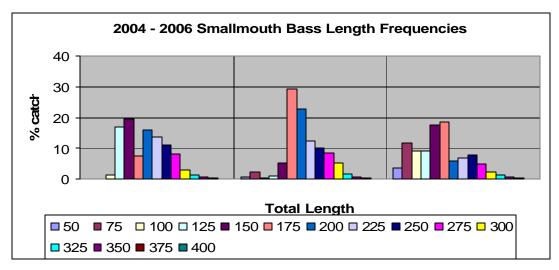


Figure 1a. 2004 -2006 smallmouth bass length/frequencies (all passes) between Echo Park and Split Mountain boat ramp.

Smallmouth Bass Catch Rates

The catch per effort for the entire reach in 2006 was 11.17 bass/hour, which is lower than in 2004 but similar to that in 2005 (Figure 2a). Consistent with previous occurrence, when the river turned turbid (pass 3), catch rates increased for bass of all size (Figure 3a).

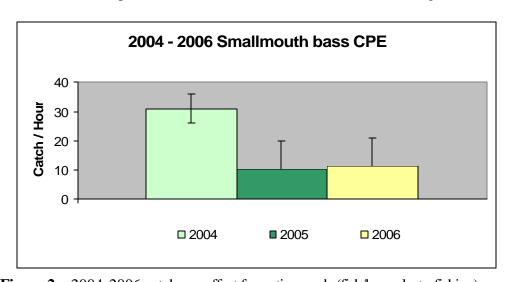


Figure 2a. 2004-2006 catch per effort for entire reach (fish/hour electrofishing)

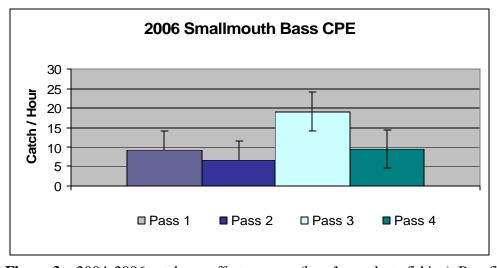


Figure 3a. 2004-2006 catch per effort per pass (bass/hour electrofishing). Pass five is not included.

Recruitment

The 150 mm size-class or age-2 cohort (Carlander 1977) is important to recruitment because, at this size, bass are fully susceptible to capture by electrofishing. Smaller bass are caught with less consistency. This age two cohort was 2006's second highest caught (Figure 1a). By following this group back to its earliest life stage in 2004, we can assess that conditions for recruitment were probably good. Likewise, in 2005 when the catch of this size-class was low, poor recruitment likely occurred in 2003.

When peak spring flows are lower than normal, and river temperatures increase to 55 7 F before high water levels are reached, good recruitment can be expected. This occurred in the years 1998, 2000 and 2001 when peak flows were less than 10,000 cfs in the lower Yampa River (unpublished data, Fuller 2004). In 2003 high flows (19,000 cfs in the Green River at Jenson gage) were linked to poor recruitment, and low spring peak flows in 2004 (11,400 cfs in the Green River at Jenson gage) with good recruitment. High water and turbidity can destroy nests (Brown, 1960) and the microcrustaceans needed by the fry (Cleary, 1956); and unstable water levels have been considered a major cause for low nest success (Neves, 1975).

Task 2. Complete four smallmouth bass collecting passes from Split Mountain boat ramp to Sand Wash boat ramp (UDWR – Vernal).

2006 Trip Summary - The first electrofishing pass for tagging smallmouth bass in the middle Green River began at the Split mountain boat ramp (RM 318) on 20 June 2006 and was completed on 13 July near the Sand Wash boat ramp (RM 215). This pass took 12 sampling days to complete. A total of 98 smallmouth bass were tagged using numbered red Floy tags and released into the river. One black crappie and ten white suckers were also caught during this pass and removed from the river. The highest densities of smallmouth bass were encountered in Dinosaur National Monument beginning at the Split Mountain boat ramp (RM 318) downriver to Horseshoe Bend (RM 284.3). Endangered fish species encountered included 11 Colorado pikeminnow and seven razorback sucker.

The first of three removal passes began at Split mountain boat ramp on 14 July and was completed on 8 August. This effort took 10 sampling days to complete and resulted in the capture and removal of 176 smallmouth bass and included one recapture. Again, the highest catch rates of smallmouth bass occurred in Dinosaur National Monument beginning at the Split Mountain boat ramp (RM 318) downriver to the Horseshoe Bend area (RM 284.3). One black crappie was also removed. Endangered fish encountered included 12 Colorado pikeminnow, three chubs and three razorback suckers.

The second removal pass for smallmouth bass in the middle Green River began on 9 August and was completed on 24 August. This pass took 10 field days to complete and resulted in the removal of 288 smallmouth bass. Ten black crappie, six bluegill, one walleye and 19 white suckers were also removed from the river. Endangered species encountered included ten Colorado pikeminnow, six razorback suckers and one chub.

The third and final removal pass began on 29 August and was completed on 26 October. This pass took 9 field days to complete and resulted in the removal of 506 smallmouth bass. One northern pike, three walleye, five black crappie, 15 white suckers and one bluegill were also removed. Endangered species encountered included 11 Colorado pikeminnow, eight razorback sucker and three chubs. Fin ray counts were done for each chub captured throughout the study. Results of this count will be incorporated into the database once completed. Highest capture rates of smallmouth bass occurred at and below Horseshoe Bend (RM 284.3).

In 2006, 1068 smallmouth bass were removed over the four electrofishing passes, only one of the fish tagged during the first pass was recaptured (Table 1b). In contrast, 1,915 smallmouth bass plus 47 recaps were encountered and removed during the four electrofishing passes in 2004 and 619 smallmouth bass and no recaptures were encountered and removed during the four electrofishing passes in 2005. The 2006 catch per unit effort for all smallmouth captured has declined by 50% since 2004 (Table 1b). Catch rates for year 2 and older fish (less than 175mm) have declined 75% from 2004 (7.97 fish/hr) to 2006 (2.05 fish/hr).

Table 1b. Catch statistics for smallmouth bass removal evaluation in the middle Green River (Split Mountain – Sand Wash): 2004, 2005 and 2006.

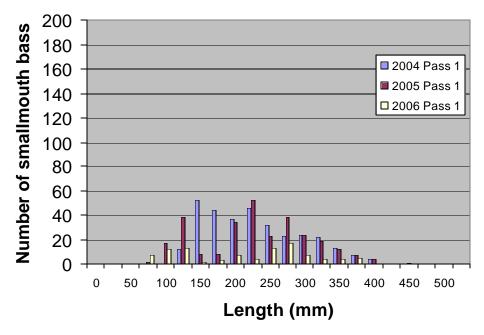
	Effort (hours)			Captures			CPUE		Number			Recaptures				
							(fish/hour)			tagged						
Pass	04	05	06	04	05	06	04	05	06	04	05	06	04	05	06	
1	57.63	51.77	68.8	320	315	98	5.5 5	6.08	1.42	320	315	98	0	0	0	
2	54.09	33.07	58.3	468	242	176	8.6 5	7.31	3.02	0	0	0	5	0	1	
3	45.99	42.85	49.45	690	281	288	15. 0	6.55	5.82	0	0	0	23	0	0	
4	48.39	26.20	50	757	96	506	15. 6	3.66	10.12	0	0	0	19	0	0	
Totals	205.10	153.89	226.55				10. 9	6.07	5.14	320	315	98	47	0	1	
Removed				1915	619	1068										

Population estimates for 2004 were calculated using the Lincoln-Peterson formula with the Chapman's correction. The initial point estimate for 2004 was 24,960 using recaps from only one pass and 12,813 using recaps from all passes. During both 2005 and 2006, recaptures were too rare to allow for a mark-recapture population estimate.

Length distributions show the presence of multiple year classes including young-of-the-year throughout the study reach. A marked decline in the number of adult fish has been observed since 2004 (Figure 3b). The decline in adult fish was offset by a large influx of year-one smallmouth bass that was observed in the 2006 catch (Figure 3b). A large proportion of the smaller bass were collected during the second, third and fourth passes in 2006 (Figures 1b, 2b, & 3b).

Dinosaur National Monument continued to have a high concentration of smallmouth bass in 2006, as did the area from Horseshoe Bend to Sand Wash.

2004, 2005 & 2006 Pass 1 Split Mountain - Sand Wash



2004, 2005 & 2006 Pass 2 Split Mountain - Sand Wash

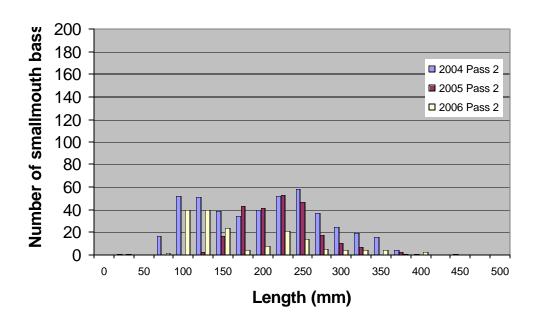
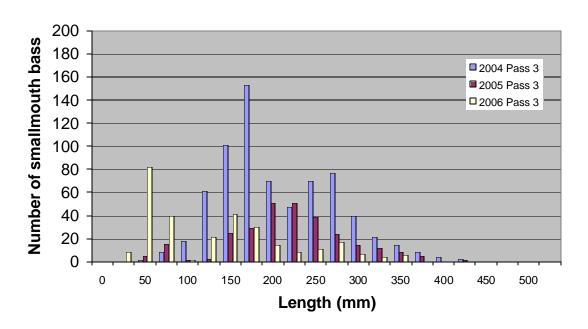


Figure 1b. Length frequency distribution of smallmouth bass collected on the first (marking) pass and the second pass on the middle Green River from Split Mountain boat ramp (RM 318) to Sand Wash (RM 215): 2004, 2005 & 2006.

2004, 2005 & 2006 Pass 3 Split Mountain - Sand Wash



2004, 2005 & 2006 Pass 4 Split Mountain - Sand Wash

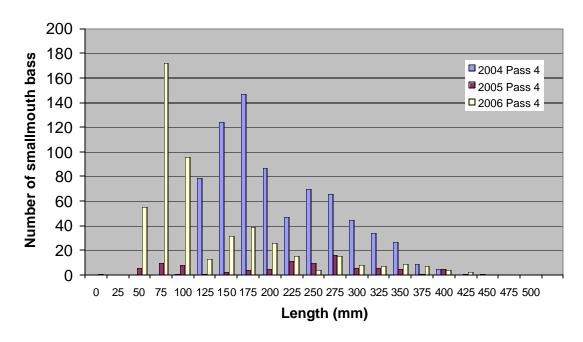


Figure 2b. Length frequency distribution of smallmouth bass collected on the third and fourth pass on the middle Green River from Split Mountain boat ramp (RM 318) to Sand Wash (RM 215): 2004, 2005 & 2006.

2004, 2005 & 2006 All Passes Split Mountain - Sand Wash

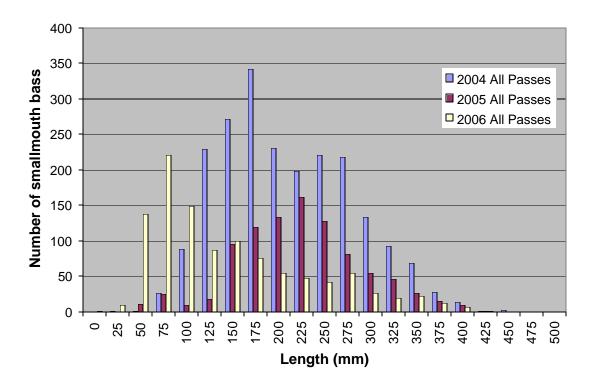


Figure 3b. Length frequency distribution of smallmouth bass collected on all passes on the middle Green River from Split Mountain boat ramp (RM 318) to Sand Wash (RM 215): 2004, 2005 & 2006.

Task 3. Complete four smallmouth bass collecting passes from Sand Wash to Swaseys Rapid (UDWR –Moab)

Four electrofishing passes were completed between Sand Wash (RM 216) and Swaseys Rapid (RM 132) between July 24 and September 18, 2006. Sixty nine hours of electrofishing effort was expended and a total of 179 smallmouth bass were captured. All electrofishing effort occurred in the upper 45 miles of the canyon due to past distributions. Efforts within the removal area were focused only on habitats which were likely to hold bass; long stretches of shallow beach were not shocked. No significant changes in distribution were observed over the three year removal period from 2004 to 2006 (figure 1c).

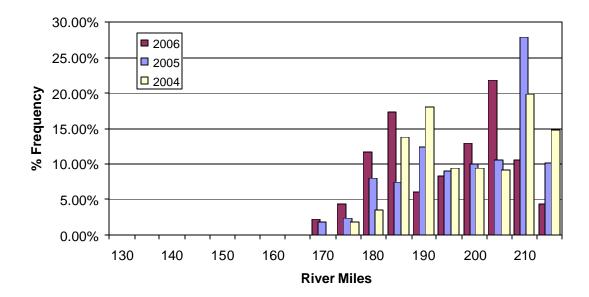


Figure 1c. Percent frequency of smallmouth bass captures by river mile between Swasey's Rapid (RM 132) and Sand Wash (RM 216).

During the first pass of 2006, forty-eight smallmouth bass were tagged with orange flag tags and released. Over the three subsequent passes, a total of 137 bass were removed. Of the bass removed, 3 were recaptured with orange tags, 1 was recaptured with a blue anchor tag (2005) and 2 were recaptured with yellow flag tags from 2004. No smallmouth bass from other sections were recaptured.

A Lincoln-Peterson population estimate was calculated for 2006, 2005, and 2004 using the Chapman's correction formula (Table 1c).

$$N = (C+1)(M+1)/(R+1)$$

Each estimate used all recaptures of marked fish in their respective year of capture. In 2005 and 2006 the low number of recaptures resulted in estimates which are unreliable. The low numbers of recaptures in 2005 was likely due to poor tag retention and in 2006 the low numbers of recaptures were most likely related to the small number of marked fish available.

Table 1c. Lincoln Peterson estimate parameters for 2004 – 2006 Desolation Canyon reach.

Year	M	С	R	N	95% C.I.
2006	42	137	3	1,918	176 – 4,108
2005	82	369	3	10,086	448 - 21,685
2004	178	937	32	5,212	3,401 – 7,023

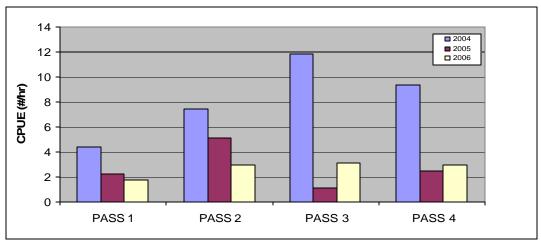
The total number of bass captured in 2006 is 38% of the 2005 catch and only 16% of the total catch observed in 2004 (Table 2c, Figure 2c). The catch per unit effort also showed a similar decline from 2004 to 2005, however, the 2006 CPUE remained the same as 2005 (Table 2c, Figure 2c). The lack of significant change in CPUE between 2005 and 2006 is due to a change in methods from continuous shoreline shocking ('04 &'05) to shocking only in primary habitats ('06), which resulted in an reduction of shocking time.

Length frequency distributions show the presence of multiple year classes including year 1 smallmouth (Figure 3c) throughout the removal period. There were no significant changes in size structure observed over the entire removal period. Between 2004, 2005, and 2006, growth of the 2-3 year old cohort can be observed.

Other non-native species removed included black crappie, bluegill, green sunfish and walleye. Endangered species collected included 26 Colorado pikeminnow, 21 humpback chub, and 3 razorback sucker. All endangered fish were weighed, measured, checked for tags, PIT tagged if needed, and released at their site of capture.

Table 2c. Catch Statistics for all smallmouth bass removal electrofishing passes in Canyon 2004-06. Recaps only include fish marked in the year recaptured.

Pass	Effort (hours)		Captures		CPUE (fish/hour)			Number			Recaptures				
										tagged					
	'04	'05	' 06	'04	'05	' 06	'04	'05	'06	'04	'05	'06	'04	'05	'06
1	40	41	23	180	91	42	4.44	2.22	1.78	178	82	42	0	0	0
2	36	27	16	270	139	48	7.42	5.08	2.96	0	0	0	14	1	0
3	21	67	15	250	75	46	11.8	1.12	3.13	0	0	0	4	0	1
4	44	63	15	417	157	43	9.35	2.50	3.00	0	0	0	14	2	1
Totals	141	198	69	1,117	462	179	7.83	2.33	2.60	178	82	42	32	3	3



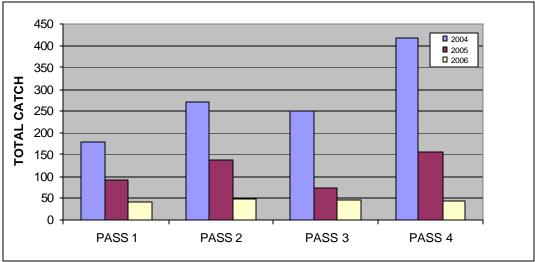


Figure 2c. Annual comparison of smallmouth bass catch per unit effort (CPUE) and total catch for each pass competed on the Desolation Canyon section of the Green River during 2004-2006

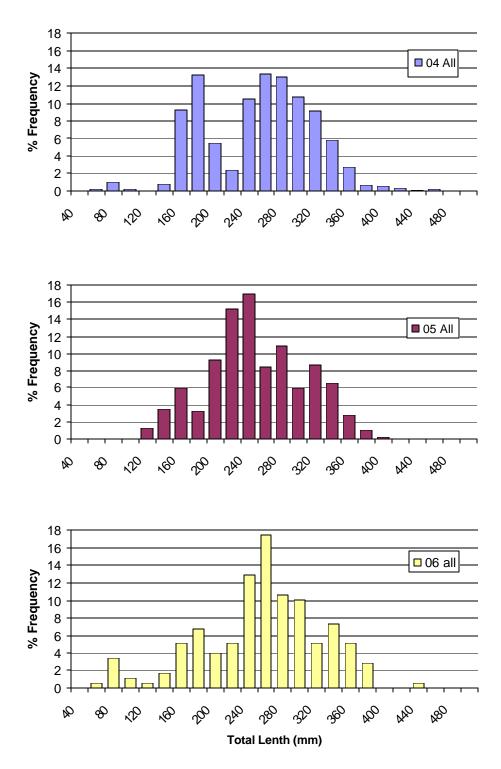


Figure 3c. Relative length frequency for all smallmouth bass captured in the Desolation Canyon reach of the Green River for 2004 through 2006.

References

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Cleary, R. E., 1956. Observations on factors affecting smallmouth bass production in Iowa. J. Wildl. Manage. 20(4):353-359.

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VII. Recommendations:

Continue to evaluate removal of smallmouth bass in the Green River.

Removal efforts in the Desolation Canyon section should be reduced due to significant reductions in catch rates (84% reduction). A general assessment of distribution and relative catch abundance in this section can be made during Colorado pikeminnow sampling in the spring of 2007.

Periods of high turbidity in upper sections of the Green River have been associated with the highest catch rates for smallmouth bass. When logistically feasible, sampling should be focused on periods just after storm events.

After the initial mark-recapture trips, removal efforts should be focused on habitats and areas of know concentrations.

Given the significant increase in YOY and age 1 smallmouth captured in the two upper sections of the Green River, removal trips in those sections should continue through September, and methods such as electric seining should be used when possible to focus on the capture of these young cohorts.

VIII. Project Status: On track and ongoing

	A.	Funds Provided: \$232,383	
	B.	Funds Expended: \$232,383	
	C.	Difference: \$0	
	D.	Percent of the FY 2006 work complete	ted, and projected costs to complete: 100%
	E.	Recovery Program funds spent for pub	olication charges: \$0
X.		as of Data Submission: Tagging data for the base manager by November 2006.	ne 2006 field season will be submitted to the
XI.	Sign	ed: Paul Badame	_11/13/06
		Principal Investigator	Date

IX.

FY 2006 Budget Status